

Clean Copy of Allowed Claims

1. A computer implemented method for simulating an image of a twisted yarn in which twisting of a plurality of yarns is simulated and an image of a twisted yarn is formed, the method comprising:

an image input step of inputting images of the plurality of yarns used for twisting, each in a form of an extended line;

an abstracting step of producing, based on the images that have been input in the image input step, an abstracted model of each of the yarns that extends in one direction and has a certain cross-section of a predetermined mathematizable shape to abstract each of the yarns, and of setting correspondence between each of the abstracted models and the images;

a twisting step of twisting, according to a predetermined condition, the abstracted models of the plurality of yarns that have been abstracted in the abstracting step and of producing an abstracted model of a twisted yarn in a form extending along a central axis thereof;

a projection step of projecting the abstracted model of the twisted yarn that has been produced in the twisting step onto a plane that is in parallel with the central axis; and

an image reproduction step of reproducing, based on the correspondence that has been set in the abstracting step, the images of the yarns on corresponding projected images of the abstracted models of the yarns included in the abstracted model of the twisted yarn that has been projected onto the plane in the projection step.

2. The method for simulating an image of a twisted yarn of claim 1, wherein in the abstracting step, cross-section shapes of the plurality of yarns input in the image input step are abstracted as round shapes to produce the abstracted models of the yarns, and the twisting step comprises:

a cross-section arrangement step of setting an arrangement reference point with respect to the twisted yarn, and of arranging the cross-section shapes of the abstracted models of the yarns produced in the abstracting step around the arrangement reference point;

a cross-section rotation step of rotating a combination of the cross-section shapes arranged in the cross-section arrangement step around the central axis of the twisted yarn while displacing the arrangement reference point set in the cross-section arrangement step along the central axis, according to a predetermined condition; and

an external shape production step of producing external shapes of the abstracted models of the yarns along the central axis of the twisted yarn as a locus formed by rotating the cross-section shapes in the cross-section rotation step.

3. The method for simulating an image of a twisted yarn of claim 2, wherein in the abstracting step, the cross-section shapes are flattened according to a predetermined condition.

4. The method for simulating an image of a twisted yarn of claim 2, wherein in the cross-section arrangement step, a cross-section region around the arrangement reference point of the twisted yarn is divided in accordance with ratios of square roots of diameters of the yarns in the abstracted models of the yarns, and the round cross-section shapes of the

abstracted models of the yarns are flattened in such a manner that the cross-section shapes of the adjacent yarns contact each other on a boundary line between the divided regions.

5. The method for simulating an image of a twisted yarn of claim 4, wherein in the cross-section arrangement step, when the ratio of the square root of diameter of yarn in an abstracted model of one yarn occupies a half or more of an entire portion, adjustment is performed so that the abstracted model of this yarn occupies only a half of the cross-section region around the arrangement reference point.

6. The method for simulating an image of a twisted yarn of claim 2, wherein the cross-section arrangement step, the arrangement reference point is set at a position different from the central axis of the twisted yarn, and  
in the cross-section rotation step, the arrangement reference point is also rotated around the central axis of the twisted yarn.

7. The method for simulating an image of a twisted yarn of claim 6, wherein in the cross-section arrangement step, the arrangement reference point is set in such a manner that the central axis of the twisted yarn is at a position that is obtained as an weighted average of relative positions of central positions of the cross- section shapes of the abstracted models of the yarns with respect to the arrangement reference point, using the diameters of the cross-section shapes as the weight.

8. The method for simulating an image of a twisted yarn of claim 2, wherein with respect to a fuzzy yarn,

in the abstracting step, the abstracted model of the yarn is produced separately for a fuzz portion on an outer circumferential side and for a yarn main portion on an inner circumferential side excluding the fuzz,

in the cross-section arrangement step, the abstracted model of the yarn is arranged around the arrangement reference point based on a cross-section shape of the yarn main portion, and a cross-section shape of the fuzz portion is arranged around the cross-section shape of the yarn main portion not so as to exceed abstracted models of adjacent yarns, and

in the image reproduction step, an image of the yarn is reproduced on the abstracted model of the yarn projected on the plane separately for the fuzz portion and for the yarn main portion from the image.

9. The method for simulating an image of a twisted yarn of claim 1, wherein in the abstracting step, the correspondence between the abstracted model and the image of each of the yarns is set so that with respect to a longitudinal direction of the abstracted model, an entire length or a part of the image is set to be a section to be used, and so that after linking is performed from one edge to the other edge of the section to be used, linking is repeated by resuming from the one edge.

10. The method for simulating an image of a twisted yarn of claim 1, wherein by using the image of the twisted yarn produced by reproducing the images of the yarns on the abstracted models of the yarns included in the abstracted model of the twisted yarn projected

on the plane in the image reproduction step, an image of a knitting fabric knitted by using the twisted yarn is simulated.

11. Canceled.

12. A computer-readable storage medium storing a program read by a computer to execute the method for simulating an image of a twisted yarn of claim 1.

13. An apparatus for simulating an image of a twisted yarn, in which twisting of a plurality of yarns is simulated and an image of a twisted yarn is formed, the apparatus comprising:

image input means for inputting images of the plurality of yarns used for twisting, each in a form of an extended line;

abstracting means for producing, based on the images that have been input in the image input means, an abstracted model of each of the yarns that extends in one direction and has a certain cross-section of a predetermined mathematizable shape to abstract each of the yarns, and for setting correspondence between each of the abstracted models and the images;

twisting means for twisting, according to a predetermined condition, the abstracted models of the plurality of yarns that have been abstracted in the abstracting means and of producing an abstracted model of a twisted yarn in a form extending along a central axis thereof;

projection means for projecting the abstracted model of the twisted yarn that has been produced in the twisting means onto a plane that is in parallel with the central axis; and

image reproduction means for displaying a state in which the images of the yarns are reproduced, based on the correspondence that has been set by the abstracting means, on corresponding projected images of the abstracted models of the yarns included in the abstracted model of the twisted yarn that has been projected onto the plane by the projection means.

14. The apparatus for simulating an image of a twisted yarn of claim 13, wherein the abstracting means abstracts the cross-section shapes of the plurality of yarns input by the image input means as round shapes, and the twisting means comprises:

cross-section arrangement means for setting an arrangement reference point with respect to the twisted yarn, of arranging the cross-section shapes of the abstracted models of the yarns produced by the abstracting means around the arrangement reference point, and for flattening the cross-shapes according to a predetermined condition;

cross-section rotation means for rotating a combination of the cross-section shapes arranged by the cross-section arrangement means around the central axis of the twisted yarn while displacing the arrangement reference point set by the cross-section arrangement means along the central axis according to a predetermined condition; and

external shape production means for producing external shapes of the abstracted models of the yarns along the central axis of the twisted yarn as a locus formed by rotating the cross-section shapes by the cross-section rotation means.

15. Canceled.

16. A computer-readable storage medium storing a program read by a computer to execute the method for simulating an image of a twisted yarn of claim 2.